Ansys

SHERLOCK

CASE STUDY /

Continental Automotive Tests its Product Reliability in a Fraction of Time Before Building Prototype

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Suppliers of automotive electronics are adopting state-of-the-art semiconductor technology to increase computational speed and capability and improve the driving experience. This approach requires thermal solutions that leverage conduction through the housing due to the power dissipated by these devices. These printed circuit boards (PCBs) typically connect to the housing through a thermally enhanced adhesive. While this arrangement can be effective, the stresses, which are transmitted into the solder joints that attach to the PCB, can cause early failures during power cycling or thermal shock. This is especially true for devices that utilize ball grid array (BGA) packaging.

Continental Automotive's goal was to evaluate three different adhesives and identify the material that provided sufficient thermal conduction and allowed the BGA to survive automotive OEM validation requirements. To optimize the design process, Continental Automotive wanted to complete this evaluation before a physical prototype was built and needed a tool that could accurately predict solder joint fatigue under this complex scenario. Continental Automotive chose Ansys Sherlock for its ability to quantify the changes in reliability of a component due to various system-level effects, including the thermomechanical influence of these adhesives.

Approach

Continental Automotive engineers built an extensive and detailed model in Sherlock. This process started with importing an ODB++ archive, an industry-standard output file from ECAD software. From the archive, Sherlock, in less than a minute, extracted key information necessary to complete a comprehensive simulation of a printed circuit board assembly (PCBA). Sherlock classified this data into intuitive categories that provided a straightforward review for the user. For Continental Automotive's analyses, accurate component and stack-up properties were vital. Continental Automotive took advantage of Ansys' free librarian service to populate their component library with the mechanical properties required for a thermomechanical analysis. Almost no work was required from Continental Automotive when building their parts' list. For the stack-up material properties, a review involved a quick visual check to confirm that Sherlock correctly parsed this information from the ODB++ file.

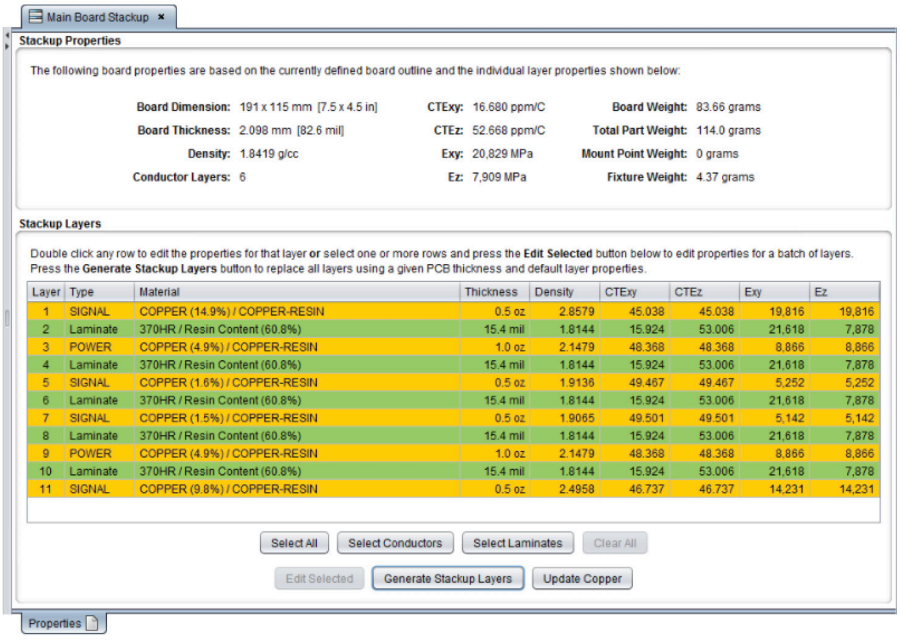

Figure 1. Sherlock's editor allows effortless definition of the PCBAs stack-up.

With any thermomechanical study, boundary conditions are mandatory. Sherlock automatically defined these constraints and presented them in a 2D or 3D viewer for verification. For all simulation runs, the adhesive materials were assumed to be fully constraining the PCB. The adhesive material characteristics, including temperature-dependent modulus and coefficient of thermal expansion, were imported into Sherlock. Typically, users can find their materials in Sherlock's considerable libraries. If there are uncommon materials that need defining, Sherlock's support team is there to assist.

After successfully developing the virtual PCBA, Continental Automotive defined reliability metric goals for the product and thermal loading specifications in the form of thermal profiles which included the test and field environmental conditions experienced by the PCB. Sherlock completed a thermomechanical analysis by establishing a Finite Element Analysis (FEA) model and applying thermal loading to the PCBA according to test and field definitions. Accurate, exhaustive results were acquired in a matter of hours.

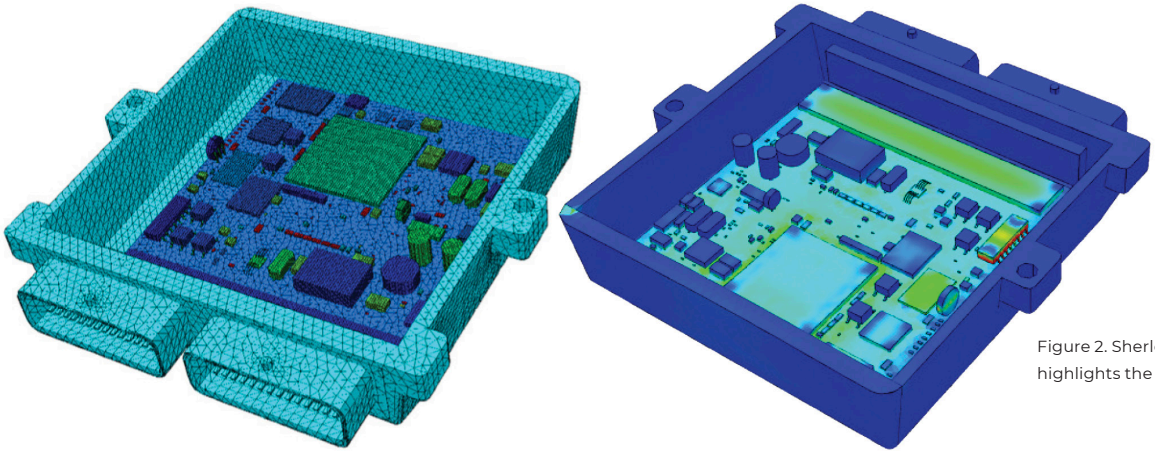

Figure 2. Sherlock's 3D viewer effectively highlights the layout of the board.

/ Key Findings

Using Sherlock, Continental Automotive accomplished its goal of evaluating and identifying a superior adhesive material before building the prototype. Key findings included:

- The superior adhesive material – the BGA survived for much longer when this material was applied, as opposed to using other adhesives.
- Increasing the thermocycling frequency of the customer-provided field temperature profile decreased the BGA life by half.
- Adding the 15°C rise in BGA temperature (due to the component power dissipation) to the field environment profiles resulted in an even lower time to failure.

/ Benefit: Why Ansys Sherlock was an Ideal Solution for Continental Automotive

Continental Automotive implemented Ansys Sherlock during the design of experiments (DOE) phase to successfully determine the required parameters for efficient and effective testing. This significantly shortened overall testing time, and not only accurately measured the reliability of the material under various thermal conditions but also predicted the life span of the product. Sherlock proved to be an ideal solution for quantifying, understanding and predicting the life curve for components under test conditions, in field environments, experiencing various system-level effects in a significantly shorter time than using any other method.

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